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GB 2207159 A WO 93/20328 A WO 92/06279 A
US 4444277 A

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(71) Applicant(s)
AEA Technology plc

(incorporated in the United Kingdom)

Patents Department, 329 Harwell, DIDCOT, Oxfordshire, OX11 ORA, United Kingdom

(72) Inventor(s)
John Murison Stewart
Simon Jeremy Merrington Briscoe
Andy Bowman

(74) Agent and/or Address for Service
Peter Turquand Mansfield
AEA Technology plc, Patents Department, 329 Harwell, DIDCOT, Oxfordshire, OX11 ORA, United Kingdom

(54) Disposal of waste materials on an oil rig

(57) Drill cuttings or scale for treatment at a remote e.g. offshore site (10, Fig 1) are transported using container 40. The container 40 has an outlet port with valve (56, Fig 3), sloping bottom 43, screw conveyor 48 and preferably beaters 52. The screw conveyor 48 is operable externally and preferably also drives the beaters 52. Preferably the container 40 has lifting lugs (62, Fig 3) to allow removal from a drilling ship or platform by crane. Preferably the cuttings are separated from the drilling fluid using a shaker 26 and pressed in a filter 32 before entering the container 40. At the remote site (10, Fig 1) the cuttings are unloaded and treated e.g. by being ground, formed into a slurry and re-injected into the well.

Fig.2.

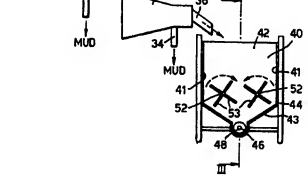

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Fig.1.

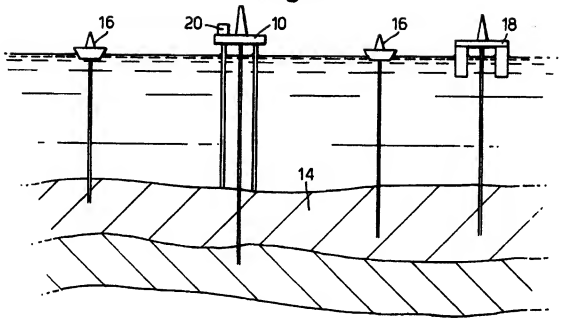
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Fig.2.

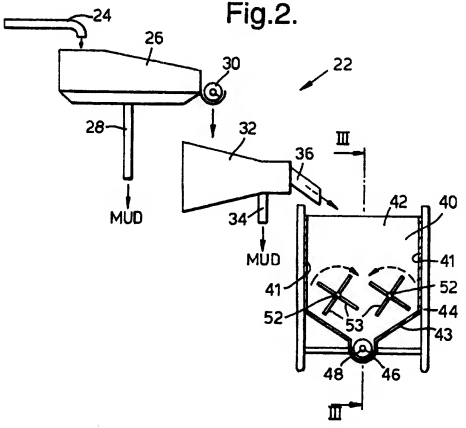
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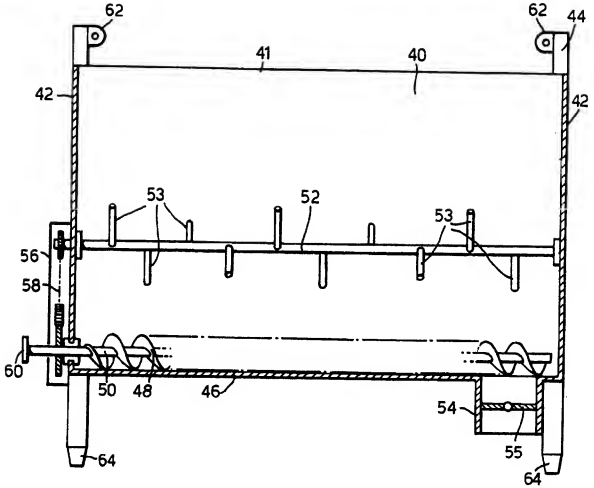
Fig.3.



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Disposal Of Waste Materials on an Oil Rig

This invention relates to a process for disposing of large quantities of waste material generated during operation of an oil rig, such as drill cuttings or scale, and to an apparatus for performing this method.

During the operation of an oil rig large quantities of waste material are generated: during drilling, in the form of drill cuttings which may be contaminated with drilling mud, and during scale removal, where the waste material is in the form of a slurry of slightly radioactive scale. The disposal of such particulate waste material can lead to environmental problems, and a variety of processes have been developed to dispose of them safely; as a general rule it is permissible to dispose of waste material by returning it to the rock strata in the field from which it was obtained. For example Jackson (EP 0 496 850/ARCO) describes a system in which cuttings mixed with sea water are converted into a viscous slurry by passage through a centrifugal pump which shears the cuttings into small particles, and Hopper (GB 2 239 471/BP) describes a system in which cuttings and salt water are fed to a crusher and then a slurry storage tank. In each case the resulting slurry may then be injected into a subterranean formation. Whatever method is used to reduce the particle sizes (high-shear pump, crusher, or other mill), this part of the overall disposal process typically requires large and expensive equipment. Where there are several drilling sites in the same area it may be more economical to transport the cuttings from each such site to a central disposal plant, although such cuttings are not easy to handle without spreading contamination.

According to the present invention there is provided a process for disposing of large quantities of waste material generated during operation an oil rig, in which the material is put into a container with a base and sides, and a discharge port in or near the base, and with a screw conveyor adjacent to the base arranged when rotated to convey cuttings to the discharge port, and means accessible from outside the container to enable the screw conveyor to be rotated, the container is transported to a disposal site on an oil rig, the screw conveyor is operated to discharge material from the container, and the material is then formed into a slurry and injected into a permeable rock formation.

The container may be open-topped, or may have a top with one or more inlet ports through which drill cuttings can be introduced to fill the container. There is desirably a lid for the or each inlet port, and also a removable sealed cover or a valve for the discharge port. The base desirably slopes downwardly towards the screw conveyor. The rotation-enabling means for the conveyor might comprise a motor forming part of the container, for example a hydraulic or electric motor, with accessible means to connect it to an appropriate power source, or it might comprise an accessible coupling for a drive motor.

Thus the container can be filled with drill cuttings, which may be accompanied by a proportion of mud and/or liquids, at a drilling site. When full, it is transported to the central treatment site, and coupled to the drive motor or to the hydraulic or electric supply. The discharge port is opened, and the screw conveyor operated to eject the cuttings at a controlled rate.

The container may also contain a mechanism such as rotatable breaker bars, to ensure the cuttings fall down

to the conveyor, and this is desirably driven by the same drive motor as the conveyor. This breaking mechanism may be coupled to the screw conveyor, for example by a drive chain. Such a breaking mechanism is particularly beneficial where an oil-based drilling mud has been used, as the cuttings will be sticky.

The process of forming the particulate waste material into a slurry usually involves a milling, grinding or shearing process to reduce the particle sizes, and mixing with water. The strata into which the slurry is injected may be a porous or fractured rock. Different waste materials may be simultaneously slurrified and injected, for example slightly radioactive scale may be mixed with drill cuttings before the slurry is formed.

Preferably the method also includes subjecting the drill cuttings to high pressure in a filter press to remove the bulk of the associated liquids and mud, before the cuttings are loaded into the transport container. This enables much of the drilling mud to be reclaimed, and it reduces the quantity of material to be transported and subsequently processed.

The invention will now be further and more particularly described, by way of example only, and with reference to the accompanying drawings in which:

Figure 1 shows a diagrammatic elevational view of a sub-sea oil-drilling system;

Figure 2 shows a side view, partly diagrammatic and partly in section, of plant for use in the system of Figure 1; and

Figure 3 shows a sectional view on the line III-III of Figure 2.

Referring to Figure 1, when drilling for oil from a sub-sea oil field a variety of different drilling rigs may be used. In this example there is a jack-up drilling rig 10 standing on the sea bed 14, two rigs on drilling ships 16, and a floating drilling platform 18. Each drilling rig brings drill cuttings to the surface when drilling, but it is economically beneficial to provide a single drill cuttings disposal plant 20 for all the rigs, which in this case is located on the jack-up rig 10. The plant 20 grinds drill cuttings with seawater to form a slurry in which almost all the particles are smaller than 0.3 mm, and then injects the slurry at high pressure down a well annulus into a subterranean rock formation; this process is referred to as cuttings re-injection. It is therefore necessary to transport drill cuttings from the ships 16 and the platform 18 to the rig 10.

Referring now to Figure 2 there is shown the plant 22 used on each of the ships 16 and on the platform 18 to collect drill cuttings. The mixture of drill cuttings and drilling mud from the drill is supplied as a stream 24 to a shale shaker 26. Much of the mud passes through the shaker 26 to emerge through a duct 28, and can be reused. The drill cuttings together with some of the mud are transferred from the shaker 26 by a screw conveyor 30 to a screw filter press 32, in which they are subjected to a high pressure (for example up to 10 atmospheres (1 MPa)) so as to squeeze out most of the mud, which emerges through a duct 34; this mud can be combined with the mud in the duct 28. The resulting cuttings are substantially free of mud or other liquids, but are sticky. They emerge through a chute 36 to fall into a transport container 40.

The container 40 is of generally rectangular shape with an open top, with side walls 41, end walls 42, and base 43 of steel sheet. It is supported in a frame 44 of square steel tubes. Along the centre, the base 43 defines a semi-cylindrical trough 46, and on either side the base slopes down towards the trough 46. A screw conveyor 48 on a shaft 50 locates in the trough 46. Above each sloping part of the base 43 is a shaft 52 extending the length of the container 40 from which several breaker bars 53 extend radially.

Referring now to Figure 3, at one end of the trough 46 is a discharge duct 54 closed by a valve 55. At one end of the container 40 the shafts 52 and the shaft 50 of the screw conveyor 48 extend in sealed bearings through the end wall 42 so as to project outside the container 40. An external casing 56 encloses a system 58 of gear wheels and drive chains (indicated diagrammatically) such that rotation of the shaft 50 to urge cuttings towards the discharge duct 54 causes the two shafts 52 to rotate in opposite directions (as indicated by broken arrows in Figure 2). The shaft 50 projects beyond the casing 56 and has a coupling 60 on its end so it can be connected to a drive motor (not shown).

The container 40 is of such a volume that when filled with cuttings and covered with a lid (not shown) it weighs slightly less than 5 tonnes. It can therefore readily be lifted off the ship 16 or the platform 18 by crane, using lifting lugs 62 on the frame 44, to be transported by a service ship (not shown) to the rig 10. There it is lifted into position on the rig 10 by crane. Throughout these operations the cuttings remain safely enclosed. The feet 64 of the frame 44 may locate in sockets (not shown) adjacent to the cuttings disposal

plant 20, so that the coupling 60 is correctly positioned adjacent to the drive motor, and so that the discharge duct 54 connects to an inlet duct of the plant 20. The valve 55 can then be opened, and the drive motor coupled to the shaft 50 so that the rotation of the breaker bars 53 and of the conveyor 48 empties the cuttings at a controlled rate. The cuttings are hence processed by the plant 20. The empty container 40 can then be returned to the ship 16 or the platform 18 to be refilled.

It will be appreciated that a cuttings transport container may differ from that described above while remaining within the scope of the invention. For example the discharge duct 54 might be at the middle of the trough 46 rather than at one end, and the shaft 50 carry two opposite-handed screw conveyors each urging the cuttings forwards the centre. The number and shape of the breaker bars 53 might differ from that shown and indeed there may be a different number of shafts 52 carrying breaker bars 53. The shafts 52 and the shaft 50 might be driven by separate motors. And one or more hydraulic, pneumatic or electric motors might be incorporated in the container, so that it is only necessary to couple hydraulic or pneumatic hoses or electric cables to the container when it reaches the disposal plant 20. It will also be appreciated that the discharge duct 54 might merely have a removable cover rather than a valve, and that where a valve is provided it might be a butterfly valve or a gate valve, or another type of valve. Equally the container might be provided with a fixed lid or cover with inlet ports through which the cuttings can be fed. And the container walls 41, 42 and base 43 might be of a different material, such as glass-fibre reinforced plastic.

Where the transport container is being used for slightly radioactive material, such as scale from oil wells which typically contains salts of both radium and thorium and so emits alpha, beta and gamma radiation of low intensity, the container is desirably made of thicker steel than for transporting other waste materials. For example, for transporting drill cuttings, the container might be made of steel sheet which was 4 mm or 5 mm thick, while for transporting scale it might be 10 mm or 12 mm thick so as to provide adequate shielding around the scale. It would also be possible to line the container inside or outside with a sheet of lead to further improve the shielding.

Claims

1. A process for disposing of large quantities of waste material generated during operation an oil rig, in which the material is put into a container with a base and sides, and a discharge port in or near the base, and with a screw conveyor adjacent to the base arranged when rotated to convey cuttings to the discharge port, and means accessible from outside the container to enable the screw conveyor to be rotated, the container is transported to a disposal site on an oil rig, the screw conveyor is operated to discharge material from the container, and the material is then formed into a slurry and injected into a permeable rock formation.

2. A process as claimed in claim 1 wherein waste from a plurality of different oil rigs is disposed of at a single disposal site.

3. A process as claimed in claim 1 or claim 2 which also includes subjecting the waste materials to high pressure in a filter press before feeding the waste materials into the container.

4. A process as claimed in any one of the preceding claims wherein the waste material, after discharge from the container, is ground and mixed with water to form a slurry with particle sizes less than 1 mm.

5. A process as claimed in any one of the preceding claims wherein the waste material comprises drill cuttings.

6. A process as claimed in any one of the preceding claims wherein the waste material comprises scale.

7. A process of treating waste materials generated on an oil rig substantially as hereinbefore described with reference to, and as shown in, the accompanying drawings.

P. T. Manfield

15182 MdWf

P T Manfield
Chartered Patent Agent
Agent for the Applicants

The Patent Office

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Claims searched: 1-7 **Date of search:** 22 January 1998

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): E1F FGM

Int Cl (Ed.6): E21B

Other: Online: WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
Y	GB 2,207,159 A	Tern Engineering Ltd esp. see claim 9	1, 2, 5 & 6
Y	WO 93/20328	Rig Technology Ltd	1, 4 - 6
Y	WO 92/09379	Den Norske Stats Oljeselskap	1, 4 - 6
Y	US 4,444,277	H. Roger Lewis	1, 5 & 6

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Y Document indicating lack of inventive step if combined with one or more other documents of same category.
& Member of the same patent family

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P Document published on or after the declared priority date but before the filing date of this invention.
E Patent document published on or after, but with priority date earlier than, the filing date of this application.